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(54) Title: METHOD AND APPARATUS FOR Z-DIRECTION REINFORCEMENT OF COMPOSITE LAMINATES

(57) Abstract: A method and apparatus for Z-direction reinforcement of composite laminates is disclosed. Discrete fibers are pulled through a fiber composite preform in the Z-direction by barbed needles.

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B32B 31/00

US CL : 156/91, 92, 148, 393

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 156/91, 92, 148, 393

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No.    |
|------------|--|--------------------------|
| X          | US 3,657,061 A (CARLSON et al) 18 April 1972 (18.04.1972), column 2, lines 25-42.  | 1, 4, 6, 8, 11           |
| Y          |  | 2, 3, 5, 7, 9, 10, 12-44 |
| Y          | US 5,642,679 A (MONGET et al) 01 July 1997 (01.07.1997), Figure 3.                 | 16-21                    |
| Y          | US 5,935,698 A (PANNELL) 10 August 1999 (10.08.1999), entire document.             | 22-34                    |
| Y          | US 6,360,412 A (DUVAL et al) 26 March 2002 (26.03.2002), entire document.          | 35-44                    |

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☐ See patent family annex.

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